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DEVONIAN BIOHERMS OF THE MICHIGAN BASIN

BY

ERWIN C. STUMM

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DEVONIAN BIOHERMS OF THE MICHIGAN BASIN

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ABSTRACT—The Devonian bioherms of the Michigan Basin occur in an arcuate belt extending from Silica in northwestern Ohio, through a narrow belt in southwestern Ontario between Amherstburg and Formosa, and across the northern part of the lower peninsula of Michigan from Alpena to Petoskey. These bioherms are typically small and varied.

INTRODUCTION AND ACKNOWLEDGMENTS

The Devonian bioherms of the Michigan Basin extend in an arcuate pattern from Silica in northwestern Ohio, through Amherstburg and Formosa in southwestern Ontario, and across the northern part of the Lower Peninsula of Michigan from the Alpena region on Thunder Bay to Petoskey on Little Traverse Bay (text-fig. 1). They roughly parallel the Silurian bioherms of the region but the latter are present to the north and west along the Niagara escarpment and to the south in the Wabash Valley of northern Indiana. Only in the east in southwestern Ontario do the Devonian bioherms overlap some of the Silurian ones, the latter being present in the subsurface north of Detroit in Macomb and St. Clair Counties where they are important oil and gas reservoirs. This overlap may be a result of the Chatham sag in southwestern Ontario, a structural depression which connected the waters of the Michigan Basin and western New York from Upper Silurian through Middle Devonian times.

The Silurian bioherms show a marked similarity to one another, being relatively large and composed mainly of stromatoporoids, with subordinate tabulate corals and a few rugose corals as framework builders. Some calcareous algae are present.

The Devonian bioherms, on the other hand, are characterized by their much smaller size and by their much greater faunal diversity. They are so distinct that each one presents an individual problem in paleontology, biostratigraphy, and paleoecology. Another great difference is that the Silurian bioherms are dolomitized and the Devonian ones are not. This makes the Devonian fossils much easier to identify. The Devonian bioherms occur mainly in two stratigraphic zones (text-fig. 2), one in the Detroit River Group of Lower Middle Devonian age in southwestern Ontario, and the other in the late Middle Devonian Traverse Group of Michigan and the Silica Formation of northwestern Ohio.

I wish to thank G. M. Ehlers for the photograph of the Amherstburg bioherm, John H. Tyler for the use of the figure taken from his thesis, and J. A. Fagerstrom for permission to use his photographs of the Formosa and Alpena reefs.

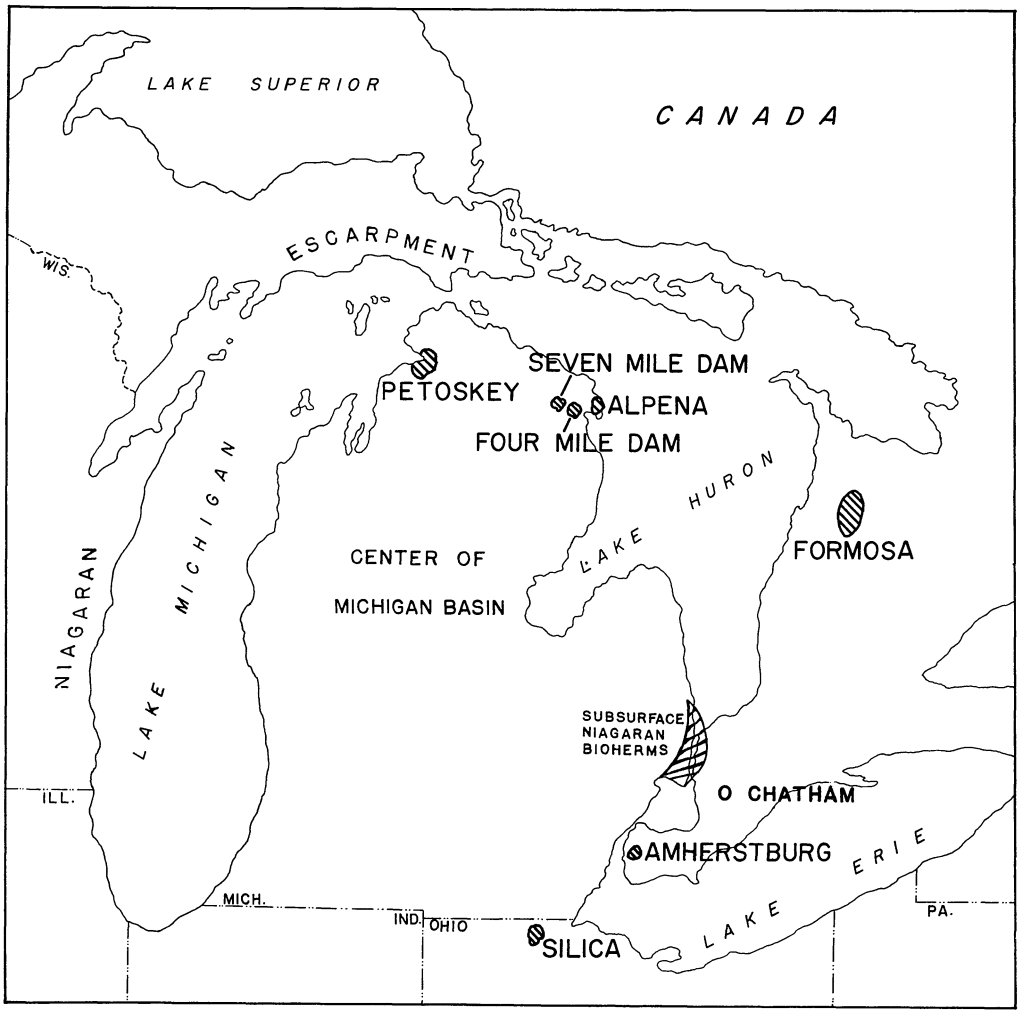
I also wish to acknowledge the great assistance of my wife Elizabeth C. Stumm in the photography of the bioherms, and of Karoly Kutasi for preparation of the enlargements.

DESCRIPTION OF BIOHERMS

A very small, oil-saturated bioherm (or possibly it should be classified a microbioherm), occurred in the west wall of the Brunner Mond Quarry at Amherstburg, Ontario. The bioherm was in the Anderdon Limestone Member of the Detroit River Group. It was about 4 feet high and 12 feet in maximum diameter. It was peculiar in being composed entirely of interlocking colonies of a digitate species of the tabulate coral *Favosites* (pl. 1, fig. 1). The bioherm was destroyed many years ago by quarrying operations.

The best known bioherms in the Detroit River Group are those located in the vicinity of Formosa, Ontario, near the east shore of Lake Huron (Fagerstrom 1961a, 1961b). There are several bioherms exposed over an area of about 150 square miles. The type bioherm has been almost completely bisected by Formosa Road, two and one-half miles north of Formosa (pl. 1, fig. 2), which gives excellent outcrops for study. This bioherm is about 350 feet long in a north-south direction and is 30 feet high.

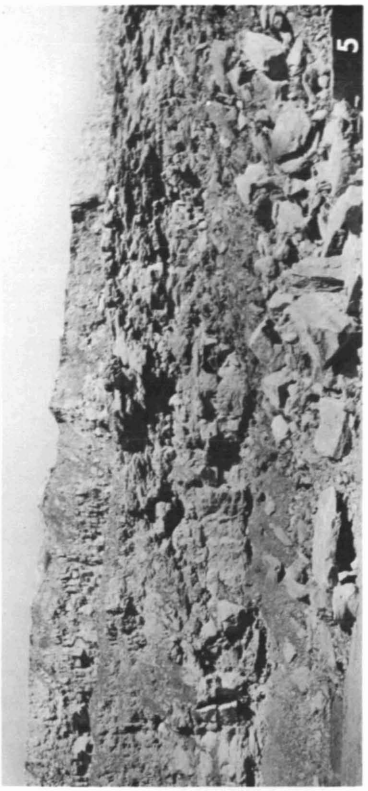
A closeup (pl. 1, fig. 3) shows part of the west face. The reef builders are stromatoporoids and subordinate tabulate and rugose corals with dwellers composed of brachiopods, molluscs, and trilobites. A paleoecological study of this bioherm has been made by Mr. P. J. Roper of the University of North Carolina (unpublished master's thesis, University of Nebraska). He determined the following distribution of reef builders and dwellers in this bioherm and kindly offered to permit me to quote from his findings. The 7 species of stromatoporoids present, determined from 93 specimens, were distributed so that the windward and leeward sides of the



TEXT-FIG. *1*—Geographic distribution of Devonian bioherms in the Michigan Basin.

EXPLANATION OF PLATE 1

FIG. *1*—Photograph of the west wall of the Brunner Mond Quarry showing the oil saturated bioherm. (Photograph by G. M. Ehlers, 1952).
2—Type Formosa Reef Limestone bioherm viewed from south.
3—Closeup view of north end of west face of the type Formosa Reef Limestone bioherm.
4—Klint formed from Formosa Reef Limestone bioherm in bed of Teeswater River, 2½ miles southwest of Teeswater, Ontario. (Photograph by J. A. Fagerstrom).
5—View of southern flank of Silica Shale bioherm with overlying glacial drift.
6—Closeup of Silica Shale bioherm core showing anastomosing *Aulocystis* colonies.



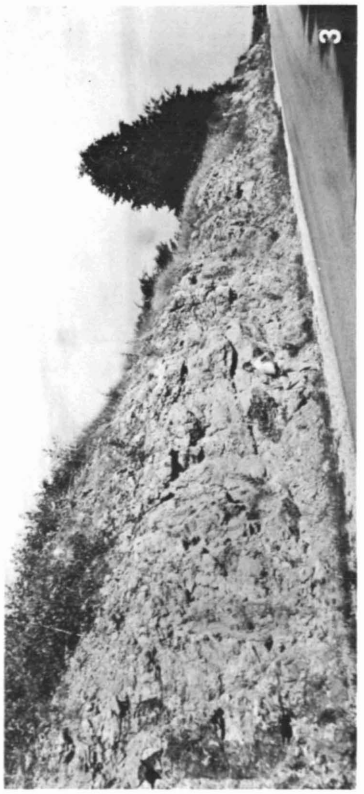
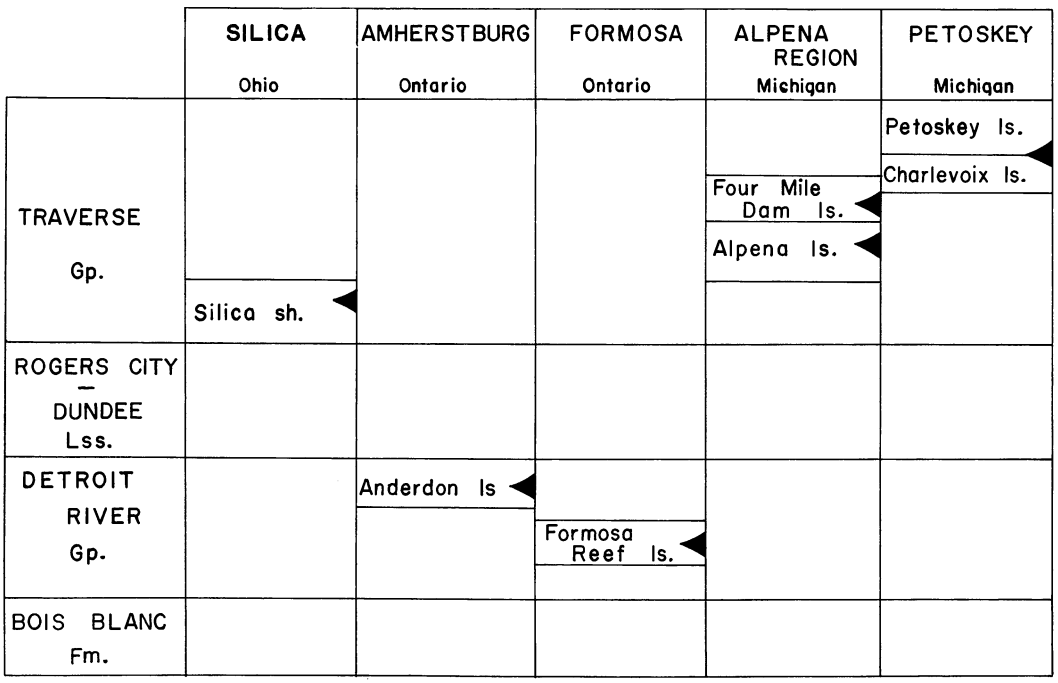


PLATE 1

bioherm could be determined. Roper divided the bioherm into five horizontal zones from south to north. These are the windward terrace, the windward resistant ridge, an intermediate area, a leeward ridge, and a leeward terrace. The stromatoporoids were concentrated on the windward terrace and windward ridge. He also found that most of the *Favosites* colonies, large rugose corals, and large cephalopods were on the windward side. Measuring vertically, he postulated a quiet water stage in the basal part, then through a semirough water stage of reef growth or shallowing of the water, and finally a wave resistant stage in the upper parts.

Another bioherm of the same composition is nearby, in the bed of the Teeswater River, where water erosion has fashioned it into a mushroom-shaped klint (pl. 1, fig. 4).

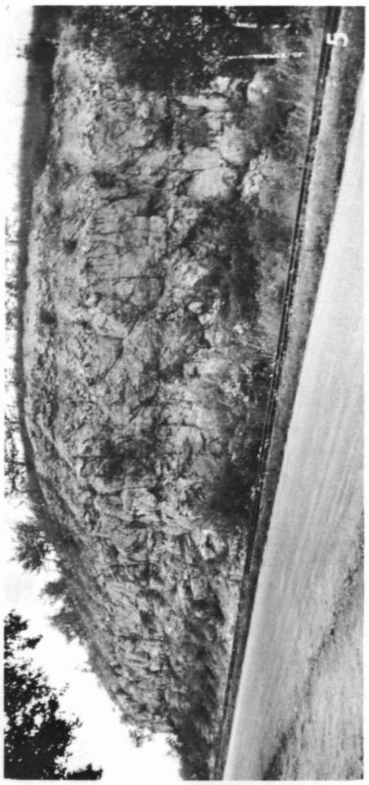
One of the most unusual bioherms occurred in the Silica Shale in the Medusa Portland Cement Company quarry at Silica, Ohio, just south of the Michigan border. It was exposed during the spring and summer of 1967. The exposure of this bioherm was brought to my attention by Mrs. Ruth Chilman, a former student at Ann Arbor. It has since been destroyed. The westward dip can be seen below the drift (pl. 1, fig. 5). This bioherm was composed almost entirely of one species of auloporoid tabulate coral *Aulocystis auloporoidea* (Davis) mixed with some crinoidal debris and a few small brachiopods. The bioherm had a maximum thickness of about 15 feet and a maximum diameter of over 100 feet. A closeup (pl. 1, fig. 6) shows the composition of the bioherm core to be an anastomozing network of the *Aulocystis* specimens. This is the first bioherm of appreciable size I have seen in

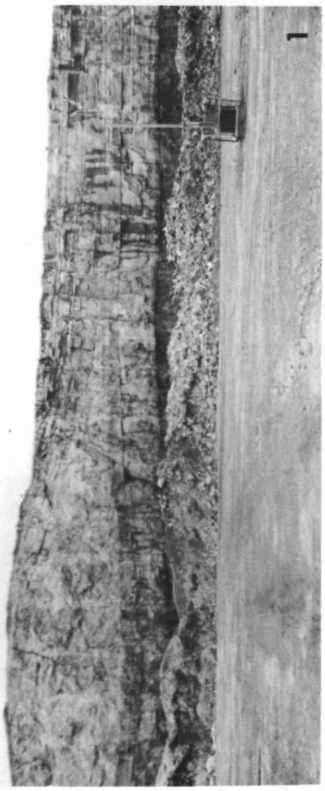


TEXT-FIG. 2—Stratigraphic distribution of Devonian bioherms in the Michigan Basin.

EXPLANATION OF PLATE 2

FIG. 1—Bioherm in Alpena Limestone in north wall of Huron Portland Cement Company Quarry, Alpena, Michigan. (Photograph by J. A. Fagerstrom, 1959).
2—East end of core and east flank of Four Mile Dam bioherm. Four Mile Dam in background.
3—Westward dipping flank beds of Seven Mile Dam bioherm under stone wall. Photograph taken from south side of river with camera equipped with telescopic lens. (Photograph by Elizabeth C. Stumm).
4—Core of Seven Mile Dam bioherm at east end of stone wall, taken with telescopic lens by Elizabeth C. Stumm.
5—Quarried northern face of Petoskey bioherm.
6—Closeup of west end of northern face of quarry. (Photograph by Elizabeth C. Stumm).





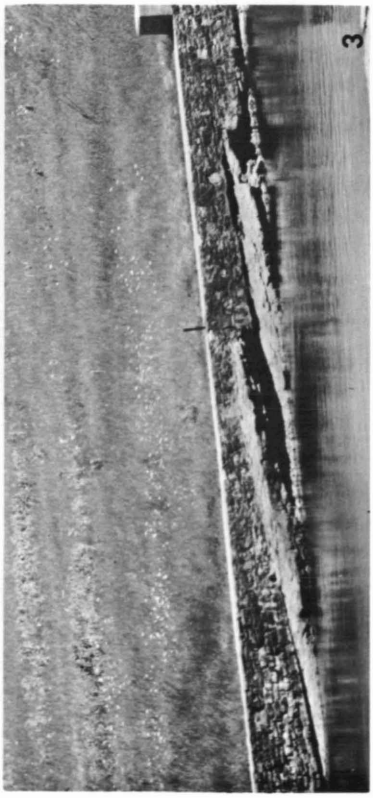


PLATE 2

shale.

The famous bioherms in the Alpena Limestone in the vicinity of Alpena, Michigan, have been observed and studied to some extent ever since the days of Rominger (1876), who mentioned "Bubble-like expansions in the limestone around Alpena," in his description of the geology of the Lower Peninsula of Michigan.

A. W. Grabau (1902) studied the stratigraphy of the Traverse Group, and published the first illustration of an Alpena Limestone bioherm (text-fig. 3). These bioherms have not been studied in detail because of their relative inaccessibility. They are well exposed in the walls of the active quarry of the Huron Portland Cement Company, the type locality of the Alpena Limestone (pl. 2, fig. 1).

The photograph (pl. 2, fig. 1), shows one present in 1959. This bioherm has a typical lens-shaped form. The convex base is probably due either to compression by overlying strata or to sinking into the unconsolidated substrate. Study of the bioherms in the wall is difficult for the blasting is almost continuous. Within a year any given bioherm has been quarried away and perhaps another has appeared. Because of the constant blasting and quarrying the bioherms can be studied only by an examination of the rubble on the quarry floor. The rubble is composed largely of the colonial rugose coral *Hexagonaria percarinata,* the well-known "Petoskey Stone," which the Michigan Legislature designated the official state stone of Michigan in 1965. Ramose and massive favositid corals, stromatoporoids, and crinoidal debris (including fairly well-preserved heads of *Dolatocrinus* and *Megistocrinus*) are present. Minor numbers of brachiopods, bryozoans, and trilobites also occur.

In the same region, above the Alpena Limestone, two bioherms occur in the Four Mile Dam Formation in the bed of the Thunder Bay River, northwest of Alpena. The first of these, the Four Mile Dam bioherm occurs in the bed of the river four miles upstream from Alpena. This is the type locality of the Four Mile Dam Formation. The western part of the bioherm was dynamited for construction of the dam but the eastern part shows the charateristic slope (pl. 2, fig. 2). This bioherm was studied in detail by John Tyler. He discovered that he was dealing with a double bioherm (text-fig. 4). The lower part (zone A) consists of coralline argillaceous biomicrite containing many specimens of *Depasophyllum adnetum* Grabau, and other corals, capped with scattered layers of the compound rugose coral *Iowaphyllum alpenense* (Rominger). Overlying this is a crinoidal biosparite (zone B) containing, in addition to the crinoid garden, a rich fauna of gastropods and brachiopods, and a smaller percentage of corals. An interesting feature is the almost complete lack of stromatoporoids in this bioherm, only one specimen being known. Apparently zone B was deposited nearer wave base and in more turbulent waters than zone A.

Three miles farther up the Thunder Bay River occurs Seven Mile Dam (sometimes known as the Norway Point Dam). This dam is also constructed on the northern end of a bioherm in the Four Mile Dam Formation. This bioherm is exposed on the north bank of the river on private property and is inaccessible for study at the present time. A stone wall has been built over part of the bioherm. As seen from the south side of the river the westward dipping flank beds can be seen beneath the stone wall (pl. 2, fig. 3), and the core is visible at the east end of the wall (pl. 2, fig. 4). There is a great deal of speculation as to whether the structure of the Seven Mile Dam bioherm is similar to that of the one at Four Mile Dam but proof must wait until this outcrop can be studied in detail. Overlying shaly beds exposed at the south bank of the river are the type locality of the Norway Point Formation, and apparently overlie the south flank of the bioherm.

The largest and most spectacular bioherm in the Michigan Basin is the one exposed along the south shore of Little Traverse Bay at Petoskey, Michigan. This was formerly quarried for limestone but has been abandoned for many years. This reef was studied by M. A. Fenton (1930), and is the nearest approach to a true stromatoporoid bioherm in the Michigan Basin.

TEXT-FIG. 3—A. W. Grabau's 1902 original figure of an Alpena Limestone bioherm.

The northern face of the bioherm is well illustrated (pl. 2, fig. 5). Fenton's study indicated that this bioherm was composed of three superposed layers separated by thin zones of thinly bedded limestones. With the subsequent weathering and present outcrop area these zones are difficult to distinguish. Stromatoporoids make up over 80% of the bioherm framework, and tabulate and rugose corals account for most of the remainder. A closeup of the west end of the exposed part of the bioherm is shown (pl. 2, fig. 6). A few brachiopods and bryozoa are present but crinoids are extremely rare.

In summary, the Devonian bioherms of the Michigan Basin are very diverse as to form and framework builders and are certainly deserving of further structural and paleoecological study.

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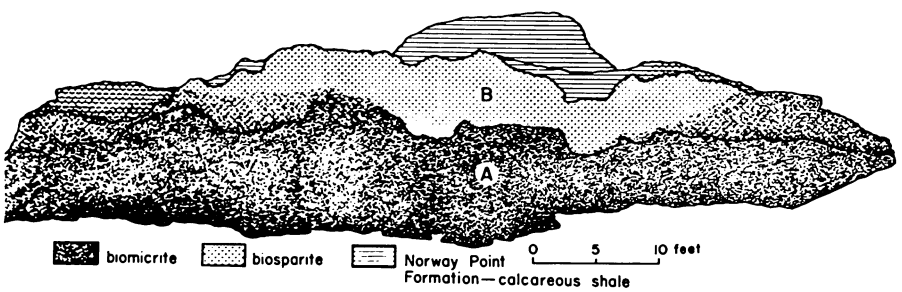

TEXT-FIG. 4—Drawing of stratigraphic zones in Four Mile Dam bioherm. Original in thesis of John H. Tyler.